SPAWAR Systems Center PACIFIC

Space and Naval Warfare Systems Center Pacific (SSC Pacific)

ROBOTICS UPDATE

"Providing network-integrated robotic solutions for C4ISR applications."

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Automatically Deployed Communication Relays Team Wins Award

Unmanned Systems Branch members (l-r) Kevin Holz, Abraham Hart, Hoa Nguyen, Aaron Burmeister, and Narek Pezeshkian, with the Deployer mounted on an iRobot PackBot.

Over the past few years, the Unmanned Systems Branch (Code 71710) developed the Automatically Deployed Communication Relays for extended non-line-of-sight RF communications to unmanned ground vehicles. The system continuously monitors the network and deploys radio relays, known as Relay Bricks, before the RF link to the base station breaks. The automatic deployment process is completely transparent to the operator, who has the option to intervene and command the release of a Relay Brick. This technology was the Navy's winner in the 2008 Office of Technology Transition and Department of Defense (DoD) TechMatch Hot Technologies Contest, which reviews projects with significant military and commercial value and selects one winner from each service.

Personnel operating in life-threatening hazardous environments, such as mining and explosive ordinance disposal, increasingly use robots for safety and property protection.

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Autonomous Robotic Mapping System Prepares for AEWE

The Urban Environment Exploration (UrbEE) team is maturing autonomous behaviors developed in the laboratory to operate under the challenging conditions encountered in urban environments. Over the last several months the UrbEE team has been testing SSC Pacific's Autonomous Capability Suite (ACS, pronounced "aces"), at a Military Operations in Urban Terrain (MOUT) training site at Camp Pendleton.

Mapping and exploration were evaluated as a function of topological accuracy (detection rate minus the false-positive rate versus ground truth) and dimensional accuracy (percent difference between actual and mapped dimensions for each room). The resulting maps from each mission had an average of 91% topological correctness and 95% dimensional accuracy.

A typical test sequence consisted of an operator driving the robot to the entrance of a building of interest (via teleop or GPS waypoints), selecting the building in the Multi-robot Operator Control Unit (MOCU), and then commanding the robot to automatically explore that zone. When the search was complete, the robot did a retro-traverse to the starting location. The resulting test data showed that the robot was able to achieve an average localization error of <0.8% over an average distance

The Camp Pendleton MOUT site features multi-story buildings, rough terrain, and paved/unpaved roads.

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Unmanned Ground Vehicle Technology Survey

SPAWAR Systems Center Pacific is conducting a market survey of unmanned ground vehicles (UGVs) for the Office of Naval Research (ONR). The effort is focused on unmanned ground systems capable of supporting an increase in the mobility of dismounted Marines. If you are interested in responding to this market survey, please visit http://www.spawar.navy.mil/robots/ and download the form.♦

Automatically Deployed Communication Relays (*continued*)

Relay Brick with extended antenna (right) shown behind the robot (left) after deployment.

Control of these tele-operated systems has provided insufficient standoff due to line-of-sight communication constraints. Platform independent, the Automatically Deployed Communication Relays system transparently deploys relay bricks that self-right and extend an antenna.

According to electrical engineer Narek Pezeshkian, Code 71710, "There was a five-to-six-fold increase in the distance achieved for effective communication in one of our non-line-of-sight lab tests. This technology has the potential to change warfighting, decreasing operator risk by providing a greater stand-off range from the robot."

The Technology Transfer (T2) office at SSC Pacific spearheaded the contest submission. Subsequently, license agreements have been signed with three companies: GEMCITY (a manufacturing company that builds the iRobot PackBot), DRS, and Intesys.

"I have never seen as much interest in other technologies that we have marketed," said Dr. Stephen Lieberman, head of T2 at SSC Pacific. "We have had to create new procedures and strategies for tracking and managing the interest in this technology."

As the contest's reward, a marketing video for the ACDR project was created by Media Marketing Consultants, funded by DoD TechMatch. It can be viewed at http://www.dodtechmatch.com/DOD/TechAd/View.aspx?id=10077.♦

Autonomous Robotic Mapping System Prepares for AEWE (*continued*)

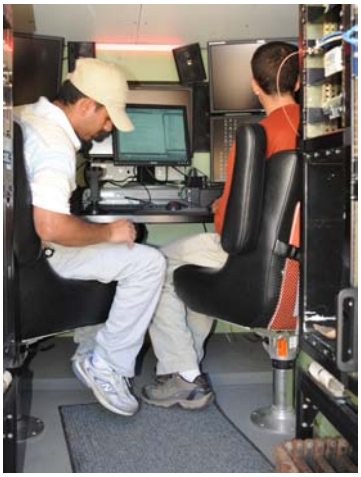
Close-up of first-generation Navigatior Payload on a Packbot Scout at the Camp Pendleton MOUT site.

traveled of 306 meters. The adaptive localization system filtered sensor data from GPS, a rate gyro, magnetic compass, and simultaneous localization and mapping (SLAM), allowing the robot to seamlessly navigate between GPS and GPS-denied areas.

The test platform used was an iRobot Packbot Scout with a first-generation Navigator Payload. The core ACS behaviors supporting exploration were SLAM, goal generation/selection, path planning, and adaptive localization. The SLAM library integrated into ACS is SRI International's Karto.

The Camp Pendleton MOUT facility was selected as the test site because of its variety in building characteristics, paved/unpaved roads, and rough terrain. Additional FY09 tests include autonomous exploration of larger zones with multi-story and damaged buildings.

In September of this year, the UrbEE team will participate in a joint Army-Navy-Industry field experiment at Ft. Benning, GA in cooperation with the Army Research Laboratory (ARL). Specific goals of this experiment are to assess the performance of semi-autonomous behaviors and the impact of voice control in support of the Army's Safe Operations of Unmanned Systems for Reconnaissance in Complex Environments efforts. Think-a-Move's in-ear voice-control system is being integrated with SSC's MOCU to provide a multi-modal control interface. Lessons learned will feed into the second-generation ACS system that will participate in Spiral F of the Army Expeditionary Warrior Experiment (AEWE) in January 2010. The UrbEE team will continue behavior optimization through FY11, progressively testing against more challenging urban characteristics.♦



UrbEE engineers monitoring the PackBot from Humvee C2 station during an exploration test run.

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